Product Specification

KENNEDY
A Division of Shugart Corporation

Auto-Load Digital Tape Drive

Model 9610/9660

KENNEDY
COMPANY

ENGINEERING
PRODUCT SPECIFICATION

MODEL NO.: 9610 / 9660

PART NUMBER: 80-09610-004

PRODUCT: Quad Density Start/Stop Streaming Tape System

DATE: April 24, 1987

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1. SCOPE

This is the Kennedy Marketing Product Specification. This document shall specify the features, functions and performance of the Kennedy models 9610 and 9660 tape systems.

This document shall be maintained under formal engineering change control and shall represent the primary definition of the product.

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2. REFERENCE DOCUMENTS

2.1 GENERAL

The following documents are referred to within this specification :

EIA Standard	Racks, Panels and Associated Equipment RS-310b
UL478	Electronic Data Processing Units and Systems
CSA C22.0	Data Processing Equipment C22.0 No. 154-M1983
VDE 0806	Office Equipment Safety, 08.81
VDE 0876	Radiated and Conducted Emissions, 6.78, class b
IEC 380	Safety of Electrically Energized Office Machines
IEC 435	Radiated and Conducted Emissions
FCC	Regulations 47, Part 15, Subpart J, Class A.

2.2 ANSI

The following standards from the American National Standards Institute are referenced in this document:

ANSI X3.22-1983	Recorded Magnetic Tape for Information Interchange (9 track, 800 cpi, NRZI)
ANSI X3.39-1986	Recorded Magnetic Tape for Information Interchange (9 track, 1600 cpi, PE)
ANSI X3B5/85-194-A	Recorded Magnetic Tape for Information Interchange (9 track, 3200 cpi, DDPE)
ANSI X3B5/85-156	Recorded Magnetic Tape for Information Interchange (9 track, 6250 cpi, GCR)
ANSI X3.40-1983	Unrecorded Magnetic Tape for Information Interchange (9 track, 800 cpi, NRZI; 1600cpi, PE; and 6250 cpi, GCR)
ANSI X3T9.2	Small Computer System Interface (SCSI)

2.3 DEFINITIONS

Automatic Read Amplification (ARA Level Burst) - GCR:

A string of bits in all track for setting up the amplifiers.

Auxiliary Cyclic Redundancy Check (ACRC) Character - GCR:

A form of polynomial check character usable for error-detection process.

Beginning-of-Tape (BOT):

A section of tape identified as the beginning of the usable recording area physically implemented by the use of a photo-reflective marker.

Block:

A group of contiguously recorded bytes considered and transported as a unit.

Byte:

A contiguous set of 8 bits that are acted on as a unit.

Character:

A unit of information consisting of one byte plus a parity bit recorded as a unit.

Cyclic Redundancy Check (CRC) Character:

The next-to-last character placed in 9 track 800 cpi NRZI data blocks where a modified cyclic code is employed and which may be used for error detection and correction.

A polynomial check character usable for error detection in GCR.

Data Density:

The number of single-byte characters stored per unit length of tape, usually expressed as characters per inch (cpi) or bytes per inch (bpi).

Density Identification Area (ID Burst):

A burst recording at the beginning of a tape identifying the tape density as PE, DDPE or GCR depending on the tracks recorded.

DDPE:

Recording technique using phase encoded recording techniques. The recording density is double the density of PE or 3200 cpi.

End-of-Tape (EOT):

A section of tape identified as the approaching end of the usable recording area physically implemented by the use of a photo-reflective marker.

File Mark (FM) or Tape Mark:

A control block record on magnetic tape to serve as a separator between sequences of recorded blocks treated as a unit.

Flux Transition:

The position of a flux transition is defined as that point that exhibits the maximum free space surface flux density normal to the tape surface.

GCR:

Group-Coded Recording is a technique that collects groups of bits and encodes them prior to putting them on tape. The recording density is 6250 cpi and the physical density is 9042 ftpi.

Inches per Second (ips):

Units for velocity of tape.

Interblock Gap (IBG):

A dc-erased section of tape separating blocks of information.

Local Operation:

Operations setup or performed from the front panel of the unit with no influence from the Host computer.

Longitudinal Redundancy Check (LRC) Character - NRZI:

The last character placed in each block of NRZI data for the purpose of checking parity of each track in the block in the longitudinal direction, and for restoring all tracks to the dc-erase polarity.

NRZI:

Recording technique using nonreturn-to-zero - change on ones recording techniques. The recording density is 800 cpi.

PE:

Recording technique using phase encoded recording techniques. The recording density is 1600 cpi.

Physical Recording Density:

The number of recorded flux transitions per unit length of track, e.g., flux transitions per inch (ftpi).

Remote Operation:

Operation of the unit by the Host computer.

Start/Stop Operation:

Unit operation that allows the tape to ramp up or down in the IBG area of any density selected.

Streaming Operation:

Unit operation that allows the Host computer a full IBG period (dependent on density and tape speed) to send a valid command in the same direction of tape motion without executing a reposition sequence. If the command is not received, the unit will enter a reposition routine that will place the tape in an area other than the related block IBG.

Vertical Parity Error (VPE):

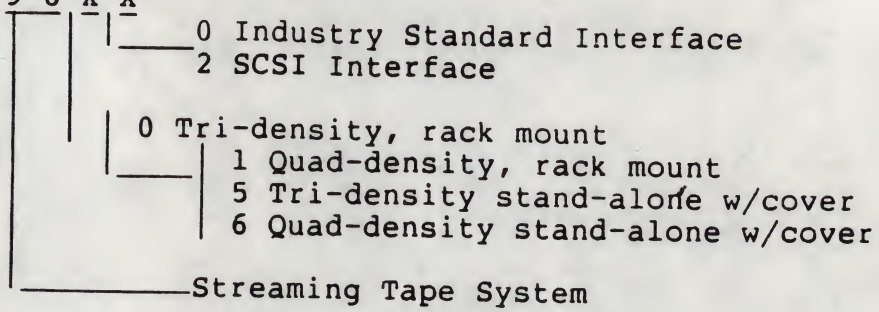
Parity error that occurs across the nine tracks of data placed on tape.

3. PRODUCT OVERVIEW

This section explains the model designation system used by Kennedy Co. for the 9600 product series of which the models 9610/9660 are part and provides a descriptive overview of the models 9610/9660.

3.1 MODEL DESIGNATION

The following system is used to determine model numbers;
Model Number Description:



For example the Model 9660 is a Quad-density (800, 1600, 3200, 6250 CPI) Tape System with an industry standard interface and with a stand-alone cover.

3.2 MODELS 9610/9660 PRODUCT DESCRIPTION

The Model 9610 is a horizontally mounted tape drive which provides the following four ANSI standard formats and densities within one basic unit:

NRZI	800 bpi
PE	1600 bpi
DDPE	3200 bpi
GCR	6250 bpi

The drive operates in two speeds: 50 ips start/stop and 100 ips streaming.

The drive offers a choice of two interfaces; the industry standard or SCSI. NOTE: This specification covers only the industry standard interface. Refer to 80-09612-XXX for SCSI interface drive.

Data in all densities can be read in either the forward or reverse direction in both 50 ips or 100 ips tape speeds.

Automatic Speed Selection when enabled determines when Host can support 100 ips streaming, changes drive speed accordingly thus optimizing system throughput.

In addition to the normal parity and CRC testing of data, a special circuit in the Models 9610/9660 performs a full byte by byte data compare as data is read during a write operation, thus providing 100% data verification on-the-fly.

The Model 9610 is designed in a modular configuration and is part of a family of streaming tape drives having a high compatibility of parts. Designed for easy maintenance and fast service at the module level, all modules can be quickly removed and replaced. There are no manual electrical adjustments on any pcba's.

An independent drive servo electronics microprocessor, an independent formatter microprocessor, and advanced VLSI CMOS gate arrays provide powerful electronic control of the many tape drive functions.

The drive architecture, in addition to providing maximum configuration flexibility, also allows for thorough self diagnostic capability. Major functional system blocks are exercised at power-up. The internal diagnostic exerciser available through the front panel allows for extensive diagnostic module isolation when repairs are required. Furthermore, the eight character 14 segment LED display provides a full compliment of messages for alignment, troubleshooting, and on line status.

The 9660 is functionally identical to the 9610. However, it is packaged as an attractive free standing system that can be placed on a desk top.

3.3 SPECIAL GCR FEATURES

3.3.1 WRITE - READ OPTIMIZATION

3.3.1.1 TAPE MEDIA CALIBRATION

Magnetic tape media has long been accepted as a reliable, inexpensive way to store large amounts of information. With increases in linear density, however, have come concerns about the quality and consistency of media, especially when the wide range of media vendors is considered. In general, the data densities associated with NRZI, PE, and DDPE operate with generous margins for optimal write current and read output. However, for GCR densities, optimal write current is found to vary nearly +/-20% and read output voltages vary as much as +/- 40%. Reference to Figure 4-1 indicates both the variations of write current and read output for a number of tape vendors. The figure also notes the effect on data written when write current is well below or above the optimal point.

The Model 9610 and 9660 address these tape variations with both automatic and manual calibration procedures. For each media unit mounted, this system performs or has available a number of options to optimize the Write/Read Process.

3.3.1.2 AUTO WRITE CURRENT ADJUST

On non write protected tapes, write current is optimized automatically each time the unit is loaded. The unit writes short bursts of data before load point to determine the optimal write current.
Note: The Write Ring must be installed for Auto Write Current Adjust to function as described above.

3.3.1.3 ARA BURST READ GAIN CALIBRATION (GCR ONLY)

In the GCR format, following the density identification burst is the Automatic Read Amplification (ARA) burst written on all tracks.

The Models 9610/9660 provides the option of using the ARA burst to normalize the output of all nine channels at the beginning of each tape or to use the values stored from the Read Gain Adjustments performed in the calibration mode of the diagnostics.

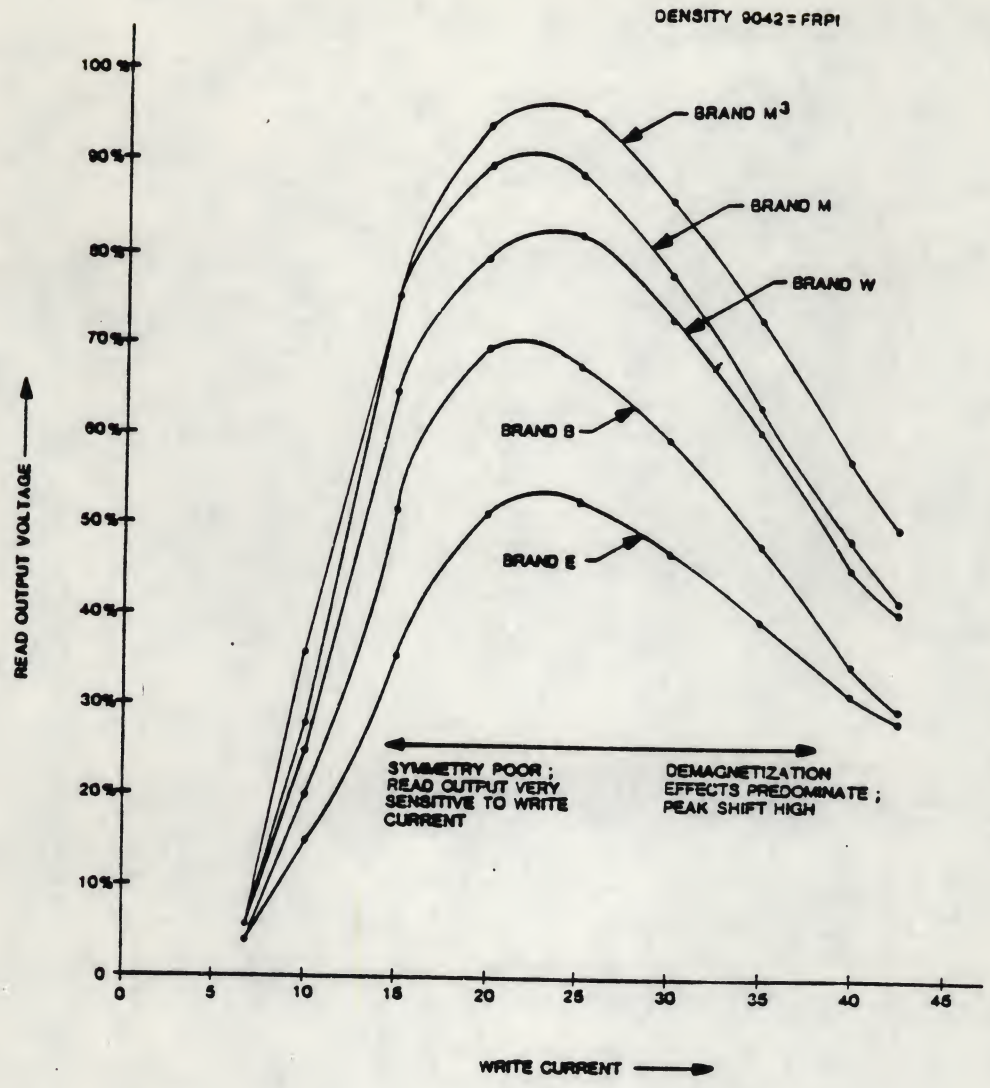


FIGURE 3-1. READ GAIN/WRITE CURRENT TAPE VARIATIONS, GCR

3.3.1.4 DEFAULT GCR WRITE CURRENT

A default value of write current for GCR employing a non write protected tape can be automatically generated by the unit in the calibration mode of the Diagnostics. The calculated value shall then be stored in the EEPROM. The default value in GCR shall be employed if the automatic write current adjust sequence fails due to damaged tape before BOT.

4. INTERFACE SPECIFICATION

4.1 GENERAL

This section describes the signal requirements and characteristics of the interface between the tape drive and the controller. The connectors and cable requirements are described, as well as the actual lines and the commands derived from the lines. The interface lines are summarized in Table 4-2 and 3 while the command structure is summarized in Table 4-6.

4.2 INTERFACE CONNECTORS

The interface connectors on the Model 9610/9660 are designed for standard fifty line shielded cables. For each active connector pin there is an associated ground pin. The mating interface connectors are two 50 pin shielded cable connectors.

4.3 INTERFACE SIGNAL CHARACTERISTICS

Signals from the controller to the Model 9610/9660 must conform to the following specifications:

LEVELS:	1 = Low = True	= 0V (+.7 Vdc)
	0 = High = False	= +3V (+/-.5 Vdc)
PULSES:	1 = Low = True	= 0V (+.7 Vdc)
	0 = High = False	= +3V (+/-.5 Vdc)

TABLE 4-1 INTERFACE SIGNAL LEVELS

Total edge transmission delay to be no greater than 200 nanoseconds over a 20 foot cable.

All output signals from the Model 9610/9660 are driven by open collector type line drivers capable of sinking up to 36 mA (25 standard unit loads) in the low true state. Open lines will result in false signal levels.

4.4 INTERFACE CABLE LENGTH

To meet FCC and ESD specifications, the maximum allowable length of the shielded cable shall be 20 feet.

Braided shielded cables are required to meet FCC and ESD specifications.

4.5 RECEIVER/DRIVER CONFIGURATION AND TERMINATION

The input lines to the transport are terminated with a 220 ohm resistor to plus five volts, and a 330 ohm resistor to ground (Figure 4-1). All input circuits have low level input voltage of 0.7 V maximum and a high level input voltage of 2.0 V minimum. The input receivers are all 74LS type circuits.

All output lines must be terminated at the far end of the daisy chained cable with a 220 ohm resistor to plus five volts and a 330 ohm resistor to ground. Output circuits are 7438 open collector drivers as shown in Figure 4-1.

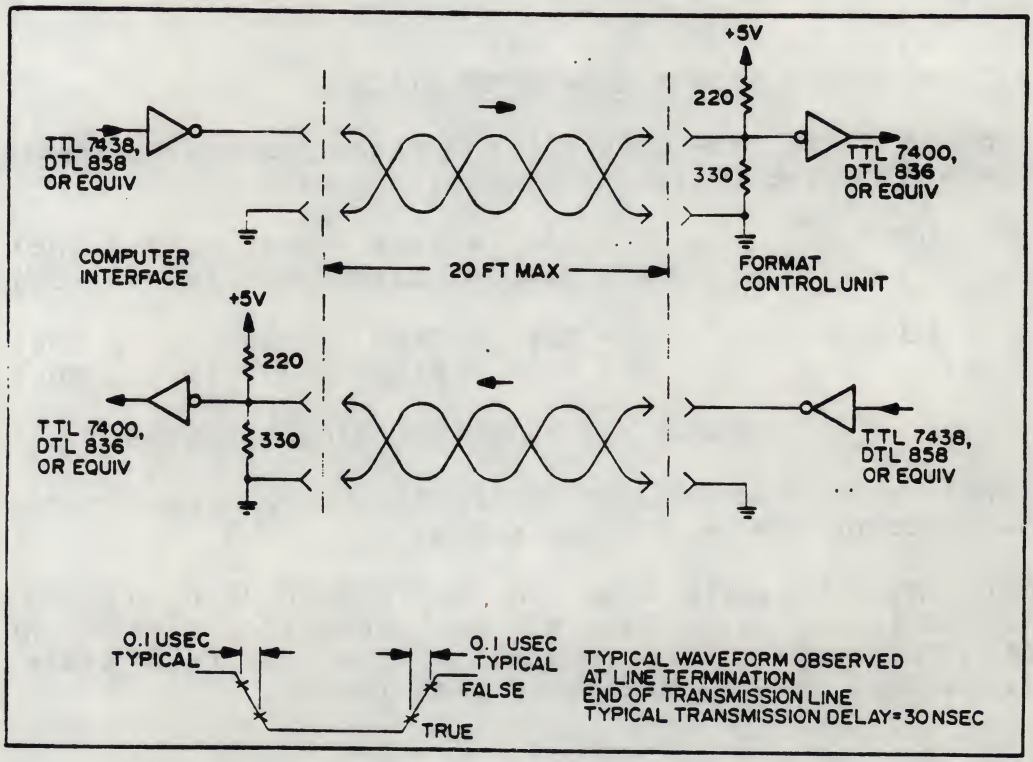


FIGURE 4-1 RECEIVER/DRIVER INTERFACE CONFIGURATION

4.6 DAISY CHAINING

The 9610/9660 transport may be configured to allow operation of up to eight transports with a single controller as shown in Figure 4-2.

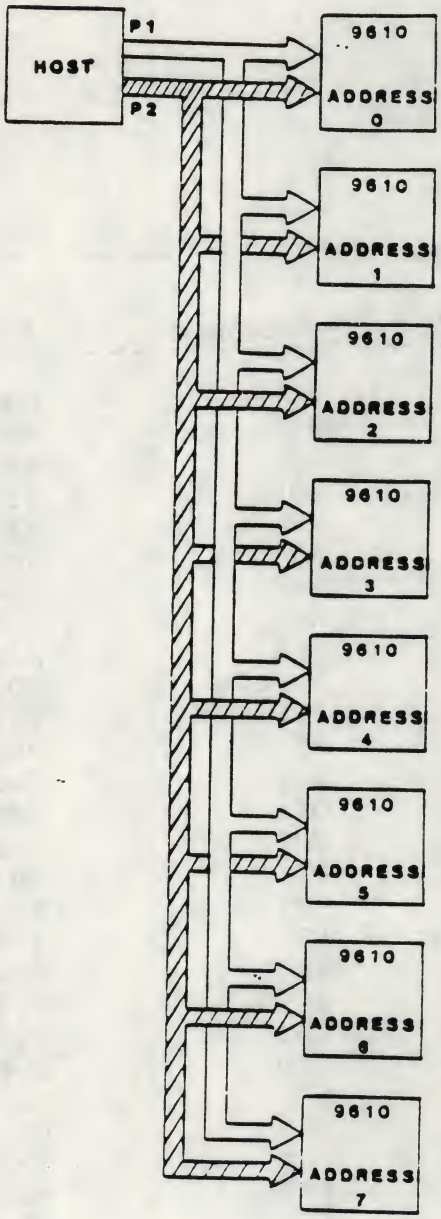


FIGURE 4-2 DAISY CHAINING

4.7 INTERFACE INPUT AND OUTPUT SIGNALS

The following sections tabulate and describe the interface signals between the Host computer and the Model 9610/9660. By definition INPUT LINES are signals from the HOST and OUTPUT LINES are to the HOST. An I/O signal list is provided in Tables 4-2 and 4-3. In the definition sections, a signal name is presented with the mnemonic designation and the connector/active pin designation.

PIN SIG/GRD	MNEMONIC	SIGNAL NAME	IN/OUT
P2-1/5	RP	Read Data P	Out
P2-2/5	R0	Read Data 0	Out
P2-3/5	R1	Read Data 1	Out
P2-4/5	LDP	Load Point	Out
P2-6/5	R4	Read Data 4	Out
P2-8/7	R7	Read Data 7	Out
P2-10/9	R6	Read Data 6	Out
P2-12/11	HER	Hard Error	Out
P2-14/13	FMK	File Mark	Out
P2-16/15	ID/CCG	ID Burst/Check Char Gate	Out
P2-18/17	FEN	Formatter Enable	In
P2-20/19	R5	Read Data 5	Out
P2-22/21	EOT	End of Tape	Out
P2-24/23	OFL	Off Line	In
P2-26/25	NRZ	NRZI	Out
P2-28/27	RDY	Ready	Out
P2-30/29	RWG	Rewinding	Out
P2-32/31	FPT	File Protect	Out
P2-34/33	RSTR	Read Strobe	Out
P2-36/35	WSTR	Write Strobe	Out
P2-38/37	DBY	Data Busy	Out
P2-40/39	SPD	Speed	Out
P2-42/41	CER	Corrected Error	Out
P2-44/43	ONL	On Line	Out
P2-46/45	TAD1	Transport Address 1	In
P2-48/47	FAD	Formatter Address	In
P2-50/49	HSP	High Speed	In

TABLE 4-2 DRIVE INTERFACE SUMMARY

PIN SIG/GRD	MNEMONIC	SIGNAL NAME	IN/OUT
P1-2/1	FBY	Formatter Busy	Out
P1-4/3	LWD	Last Word	In
P1-6/5	W4	Write Data 4	In
P1-8/7	GO	Initiate Command	In
P1-10/9	W0	Write Data 0	In
P1-12/11	W1	Write Data 1	In
P1-14/13	Reserved		
P1-16/15	LOL	Load On Line	In
P1-18/17	REV	Reverse/Forward	In
P1-20/19	REW	Rewind	In
P1-22/21	WP	Write Data P	In
P1-24/23	W7	Write Data 7	In
P1-26/25	W3	Write Data 3	In
P1-28/27	W6	Write Data 6	In
P1-30/29	W2	Write Data 2	In
P1-32/31	W5	Write Data 5	In
P1-34/33	WRT	Write/Read	In
P1-36/35	LGP	Long Gap	In
P1-38/37	EDT	Edit	In
P1-40/39	ERS	Erase	In
P1-42/41	WFM	Write File Mark	In
P1-44/43	Reserved		
P1-46/45	TAD0	Transport Address 0	In
P1-48/47	R2	Read Data 2	Out
P1-50/49	R3	Read Data 3	Out

TABLE 4-3 DRIVE INTERFACE SUMMARY

4.7.1 INTERFACE INPUT SIGNALS (9610 FROM HOST)

4.7.1.1 TRANSPORT ADDRESS, FORMATTER ADDRESS

TAD0, TAD1, FAD Level P2-48, P1-46, P2-46

The states of these lines determine which of up to eight tape drives are selected by the controller. The following list defines the tape drives addresses produced as a result of the various TAD0, TAD1, FAD.

FAD	TAD0	TAD1	ADDRESS
0	0	0	SLT0
0	0	1	SLT1
0	1	0	SLT2
0	1	1	SLT3
1	0	0	SLT4
1	0	1	SLT5
1	1	0	SLT6
1	1	1	SLT7

TABLE 4-4 TAPE ADDRESS

4.7.1.2 INITIATE COMMAND - GO

GO Pulse P1-3

A pulse which initiates any command specified by the command lines described in the following paragraphs. Information on the command lines is copied into the unit on the trailing edge of the GO pulse. At the end of the reinstruct window in streaming write commands only, it is possible for the Host to extend the reinstruct window by asserting and holding the GO pulse in a true state. The unit will continue to stream for up to one inch waiting for the falling edge of the GO pulse as the Host returns GO to the false state. If one inch is exceeded and the GO pulse has yet to be denied, the unit shall enter a reposition cycle. This feature in effect creates extended gaps.

4.7.1.3 REVERSE

REV Level P1-18

Command line refer to Table 4-6.

4.7.1.4 WRITE

WRT Level P1-34
Command line refer to Table 4-6.

4.7.1.5 WRITE FILE MARK

WFM Level P1-42
Command line refer to Table 4-6.

4.7.1.6 EDIT

EDT Level P1-38
Command line refer to Table 4-6.

4.7.1.7 ERASE

ERS Level P1-40
Command line refer to Table 4-4.

4.7.1.8 HIGH SPEED

HSP Level P2-50
When true, this signal causes the selected on-line unit to operate in the high speed mode (100 ips).

4.7.1.9 LONG GAP

LGP Level P1-36
When true during a write mode this level causes the gap selected in Setup options to be erased on tape between data blocks to allow longer reinstruct periods as opposed to a nominal gap.

4.7.1.10 REWIND

REW Pulse P1-20
A pulse which causes the transport to rewind to load point. This pulse does not cause the formatter to go busy. The Ready status will remain false during rewind. In daisy chained systems, the rewind pulse can be issued to more than one unit in the chain while allowing data transfer operations to occur on one of the units in the chain.

4.7.1.11 OFF LINE/UNLOAD

OFL Pulse P2-24
This pulse causes the transport to go off line immediately, then rewind to load point and unload the tape.

4.7.1.12 LAST WORD

LWD Level P1-4
When this level is true during write or erase command, it indicates that the next character to be strobed into the formatter is the last character of the record. LWD goes true when the last data character is placed on the interface lines.

4.7.1.13 FORMATTER ENABLE

FEN Level P2-18
When false this level causes all units in a daisy chain configuration to revert to the quiescent state. This line may be used to disable the units if controller power is lost or to clear unit logic when illegal commands or unusual conditions occur. When denied during command execution, the unit will abort the command in an orderly fashion and stop motion. The unit Setup options (Section 12) allows the polarity of this level to be selected.

4.7.1.14 WRITE DATA LINES

WP, W0-W7 Level

These 9 lines transmit write data from the controller to the formatter. The 8 data bits appearing on W0-W7 are written onto the corresponding channels on tape; W7 corresponds to the least significant bit of the character.

Line WP is optional and is utilized only if it is required to check the parity bit generated by the customer. The formatter generates odd parity internally on the basis of data contained on W0-W7.

The first character of a record should be available on these lines within one character period after DBY goes true and remain until the trailing edge of the first WSTR is issued by the unit. The next character of information must then be placed on these lines within one half of a character period. Subsequent characters of a record are processed in this manner until LWD is set true by the controller when the last character is transmitted.

INPUT LINE	ANSI CHANNEL	ANSI TRACK
W0	0	7
W1	1	6
W2	2	5
W3	3	3
W4	4	9
W5	5	1
W6	6	8
W7	7	2
WP	P	4

TABLE 4-5 TRACK IDENTITY

4.7.1.15 LOAD ON LINE

LOL Pulse P1-16
If tape is not loaded and selected, the unit will execute a load sequence. Upon completion of the load sequence, the unit will go online. If tape is loaded and selected but the unit is not online, it will go online.

4.7.2 INTERFACE OUTPUTS (9610/9660 TO HOST)

4.7.2.1 FORMATTER BUSY

FBY Level P1-2
This level goes true on the trailing edge of GO when a command is issued by the controller. FBY will remain true until tape motion ceases or optionally until DBY goes false on 100 ips commands. The unit Setup options (Section 12) allow selection of the cancellation point for FBY.

4.7.2.2 DATA BUSY

DBY Level P2-38
This level goes true during the active execution of all commands initiated by GO. A new command may be issued after DBY goes false.

4.7.2.3 HARD ERROR (All DENSITIES)

HER Pulse P2-12
When true, this pulse indicates one or more of the following error conditions has occurred. The following list summarizes the errors for all four densities.

NOTE: The HER may be reported as a real time pulse for each error condition as it occurs; or the occurrence of at least one HER or CER within the block can be captured by the Host before the falling edge of DBY at the end of the data block.

a) Longitudinal parity error.

b) Improper record format.

c) CRCC parity error.

d) Vertical parity error on a data character.

e) Host write parity error (optional).

f) Internal write/read compare error.

g) No file mark detected in Read After Write mode when executing a Write File Mark command.

h) If a gap of 25 feet is detected while executing Read Block, Space Block and Search File Mark commands (optional).

i) Read after Write compare error.

j) Excessive skew.

k) Postamble error.

l) Vertical parity error (VPE).

m) Multiple channel error.

n) CRC error.

o) ACRC error.

p) Simultaneous dropouts in two or more tracks during a write operation.

q) Simultaneous dropouts in three or more tracks during a read operation.

4.7.2.4 CORRECTED ERROR (PE, DDPE MODE)

CER Pulse P2-42
This pulse indicates that a single track dropout has been detected during read and the unit will perform a vertical parity (VPE) correction.

4.7.2.5 CORRECTED ERROR (GCR)

CER Pulse P2-42
This pulse indicates the following:

a) A single or dual track dropout has been detected and the drive performs an error correction in a Read operation.

b) A single track dropout has been detected and the drive performs an error correction in a Read after Write operation.

Note: Corrected error reporting can be disabled in GCR mode only as one of the Setup options (Section 12).

4.7.2.6 CHECK CHARACTER GATE (NRZI MODE ONLY)

ID/CCG Level P2-16
This level is set true by the unit when the read information being transmitted to the controller is the cyclic redundancy check character (CRCC) or the longitudinal redundancy check character (LRCC) of the data block. When data characters are transmitted, CCG goes false. Data and Check information can be distinguished by gating Read Strobe with CCG or its inverse. After leaving load point this line should only be used during NRZI mode.

Note: CCG and the Read Strobes (RSTR) for the check characters can be disabled as one of the Setup options (Section 12).

4.7.2.7 IDENTIFICATION BURST (PE, DDPE, GCR MODE)

ID/CCG Level P2-16
The level identifies that an ID burst is being detected for PE, DDPE, or GCR.

4.7.2.8 FILE MARK

FMK Pulse P2-14
File mark is pulsed when a file mark is detected on the tape during a read operation or during a write file mark operation. The FMK line will be pulsed after a complete file mark has been read. When reading NRZI file marks, read strobes are issued to the interface.

4.7.2.9 WRITE STROBE

WSTR Pulse P2-36
This line pulses each time a data character is written onto tape. WSTR samples the write data lines WP, W0-W7 from the Host and copies this information character by character into the unit's write logic. The first character should be available prior to the first write strobe pulse and succeeding characters should be set up within half a character period after the trailing edge of each write strobe pulse. The write strobe is also active during variable length erase command; however, no data will be written to tape.

4.7.2.10 READ STROBE

RSTR Pulse P2-34
This line consists of a pulse for each character of read information allowing the transmission of data to the host. This signal should be used to sample the read data lines RP, R0-R7.

In a NRZI Read operation the transmission of CRC and LRC data characters will be flagged by the check character gate (CCG) signal as described above under Check Character Gate.

4.7.2.11 READ DATA LINES

RP, R0-R7 **Levels**

These lines transmit the read data for all four densities. Each character read from tape is made available by parallel sampling the read lines using the Read Strobe.

The data remains on the read lines for a full character period.

4.7.2.12 READY

RDY Level P2-28
RDY is true (low) only when the transport is ready to receive external commands; the following conditions must exist:

a) All interlocks are made.
b) Initial load or rewind sequence is complete.
c) Transport is on-line.
d) Transport is not rewinding.

4.7.2.13 ON LINE

ONL Level P2-44
When ONL is true (low), the transport is under host or remote control. ONL false (high) indicates the transport is under local control.

4.7.2.14 REWINDING

RWG Level P2-30
RWG is true (low) when the transport is engaged in a rewind operation or returning to the load point at the end of the rewind operation.

4.7.2.15 FILE PROTECT

FPT Level P2-32
FPT is true (low) when a reel of tape without a write-enable ring is mounted on the transport supply hub.

4.7.2.16 LOAD POINT

LDP Level P2-4
LDP is true (low) when the load point marker is under the BOT sensor and the transport is not rewinding. After receipt of a motion command the signal will remain true until the load point marker leaves the BOT sensor area.

4.7.2.17 END OF TAPE

EOT Level P2-22
EOT is true (low) when the EOT marker is detected in the forward direction. EOT goes false (high) when the EOT marker is detected in reverse (REWIND).

4.7.2.18 NRZI

NRZ Level P2-26
NRZ true (low) indicates the selected transport is operating in NRZI mode. A false (high) level on NRZ indicates the selected transport is operating in the PE, DDPE, or GCR mode.

4.7.2.19 SPEED

SPD Level P2-40
SPD true (low) indicates the selected transport is in the high speed streaming mode. A false level indicates low speed (50 ips).

4.8 COMMAND EXECUTION

The following section describes the appropriate combinations of signal lines required to achieve Command Execution followed by a description of the responses of the Model 9610. Command configuration for the Model 9610 is shown in Table 4-6. Write and read interface timing diagrams for each density at the two tape speeds are shown in Figures 6-6 through 4-18.

COMMAND	REV	WRT	WFM	EDT	ERS
READ FORWARD	0	0	0	0	0
READ REVERSE	1	0	0	0	0
READ REVERSE EDIT	1	0	0	1	0
WRITE	0	1	0	0	0
WRITE EDIT	0	1	0	1	0
WRITE FILE MARK	0	1	1	0	0
ERASE VARIABLE LENGTH	0	1	0	0	1
ERASE FIXED LENGTH	0	1	1	0	1
DATA SECURITY ERASE	0	1	1	1	1
SPACE FORWARD	0	0	0	0	1
SPACE REVERSE	1	0	0	0	1
FILE SEARCH FORWARD	0	0	1	0	0
FILE SEARCH REVERSE	1	0	1	0	0
FILE SEARCH FORWARD (IGNORE DATA)	0	0	1	0	1
FILE SEARCH REVERSE (IGNORE DATA)	1	0	1	0	1
SELECT 800 BPI	0	1	1	1	0
SELECT 1600 BPI	0	0	1	1	1
SELECT 3200 BPI	1	0	1	1	1
SELECT 6250 BPI	1	1	0	0	0

TABLE 4-6 COMMAND CONFIGURATION

4.8.1 READ FORWARD

On receipt of the Read Forward command loaded into the unit with the GO pulse, the FBY signal goes true and the unit begins to accelerate the tape up to nominal velocity. When the tape is up to speed and the data block to be read is detected, DBY shall go true. Read Strobes (RSTR) accompany the decoded data. DBY will go false after the complete block has been read indicating readiness of the unit to accept a new command. If no command is received, the unit will either stop in the gap in 50 ips operation or enter a reposition operation in 100 ips operation and FBY will go false.

4.8.2 READ REVERSE

This command is similar to a read forward command except that the tape motion is in the reverse direction.

4.8.3 WRITE

On receipt of the Write command loaded into the unit with the GO pulse, the FBY signal goes true and the unit begins to accelerate the tape up to nominal velocity. When the tape is up to speed and the data block is ready to be written, DBY shall go true. Write Strobes (WSTR) are transmitted to the Host by the unit and the Host presents each data byte to be written. When LWD is received by the unit from the Host, the unit will finish reading the block, error status shall be made available to the Host and then the unit shall force DBY false indicating the end of the block just written. FBY will remain true if a new command in the same direction is received within the command reinstruct period. If no command is received, the unit will either stop in the gap in 50 ips operation or enter a reposition operation in all 100 ips or 50 ips GCR write operation and FBY will go false.

4.8.4 READ REVERSE EDIT

The Read Reverse Edit command besides providing data establishes the correct position of the tape relative to the magnetic head prior to the Host executing a Write Edit command.

4.8.5 WRITE EDIT

The Write Edit command must be proceeded by a Read Reverse Edit command. The Write Edit command allows a block of the same length to be written over an already existing data block on the tape.

4.8.6 WRITE FILE MARK

This command invokes the writing of a file mark in the density selected.

4.8.7 FIXED LENGTH ERASE

This command invokes a 3.5 inch length of tape to be erased. This command is always executed in the forward direction of tape motion.

4.8.8 DATA SECURITY ERASE

This command invokes tape to be erased from the present tape position to a point 3 feet past End of Tape.

4.8.9 SPACE FORWARD AND SPACE REVERSE

These commands are similar to a Read Forward or Read Reverse command, except that no read strobes are returned to the Host and no error checking is performed. However, the unit will check and report if the record is a file mark.

4.8.10 FILE MARK SEARCH FORWARD/REVERSE

A file mark search forward command causes the unit to execute a series of read forward commands and the reverse command, a series of read reverse commands searching for a file mark. Forward or reverse search is terminated by the presence of a file mark, 25 feet of blank tape, BOT in reverse search, or EOT in forward search. In the EOT region a gap of 5 feet results for a forward search termination. If the next block encountered is not a file mark and the command was issued at 50 ips, the unit will jump to 100 ips if autospeed is a selected option.

4.8.11 ERASE VARIABLE

This command causes the unit to execute a dummy write, erasing tape until Last Word (LWD) is issued by the Host. WSTR's are transmitted to the Host during the execution of this command.

4.8.12 DENSITY SELECT

Given that the unit has been placed in a remote density mode (the remote density LED is ON) from the operator panel, online and at BOT, the Host can issue a density command that will force the unit to write tapes in the density invoked. However, if the unit performs a read from BOT of a tape of different density than the density command accepted by the unit, the unit will change to the density of the tape and proceed. This command will only be accepted when the drive is at BOT, ON-LINE and SELECTed.

The Calibration mode of the diagnostics (Diagnostics Section) provides a read gain adjustment feature. The Read Gain Adjustment can be employed to set automatically or manually each of the nine read channel gain values, for all four densities at both speeds. These values are then stored in EEPROM. The read gain values stored are then employed to support NRZI, PE, DDPE, and GCR when the unit is powered up.

5. FUNCTIONAL AND PERFORMANCE SPECIFICATION

5.1 TAPE FORMATS

5.1.1 RECORDING DENSITIES

NRZI	800 bpi
PE	1600 bpi
DDPE	3200 bpi
GCR	6250 bpi

TABLE 5-1.RECORDING DENSITIES

5.1.2 DENSITY SELECTION

LOCAL	Selected from front panel only
REMOTE	a) Selected through the Host interface b) Automatic read density selection from tape ID.

5.1.2.1 DENSITY DEFAULT SELECTION

At power up, a default density stored in the EEPROM will select the initial operating density.

The default density and remote enable can be selected by the user as part of the set up mode of the diagnostic operation.

5.1.2.2 DENSITY OPERATOR PANEL SELECTION (LOCAL)

Density can be selected from the operator panel by pressing the **DENSITY SELECT SWITCH**. Repeated pressing of the switch will cycle through all densities. Density may be selected from the front panel as long as the tape is at BOT and the unit is not ON-LINE.

5.1.2.3 DENSITY INTERFACE SELECTION (REMOTE)

For a Write process a density can be selected through the interface if the drive is ON-LINE, the tape is at BOT, and the remote density select LED is illuminated on the front panel.

*See Section 4, Input signals for density select codes.

5.1.2.4 AUTOMATIC READ DEN. SELECTION (REMOTE ONLY)

During a READ operation the drive will automatically select the correct density at the beginning of tape. The recorded density of the tape will be displayed on the appropriate DENSITY LED.

If the unit is not in REMOTE density mode, the unit will attempt to read the tape in the selected density as indicated by the active DENSITY LED on the front panel. If the loaded tape is not written in the same density as indicated, read errors will result.

5.2 TAPE CHARACTERISTICS

5.2.1 TAPE MEDIA TYPES

1/2" TAPE IN THICKNESSES SUPPORTED: 1.3 mil to 1.9 mil

5.2.2 TAPE REEL SIZES

REEL SIZES SUPPORTED 6", 7", 8.5", 10.5"

5.2.3 TAPE CAPACITY

REEL SIZE(IN) CAPACITY (FT)	6	7	8.5	10.5
17.1.1.1.1 MIL TAPE	*na	*na	*na	3600
17.1.1.1.2 MIL TAPE	200	600	1200	2400

Note: na is not available

5.3 TAPE MOTION PERFORMANCE

Models 9610/9660 employ microprocessor controlled capstan and reel servo systems to control velocity and tension of the tape.

If the drive is operating at 50 ips, the unit can start and stop in the inter block gaps (IBG) on tape. Operation at 100 ips write operation in all densities and 50 ips GCR write operations will require the unit to perform an operation known as repositioning in order to allow IBG access.

The following sections detail the tape motion performance of the unit

5.3.1 TAPE MOTION DEFINITIONS

STREAMING MODE:

Figure 5-1 shows the velocity profile for streaming mode in the 9610. Many applications of tape systems call for a series of blocks of data to pass to or from the tape drive as quickly as possible such as an image backup of disk. To facilitate this high performance in tape drives without incurring the unit expense of vacuum column buffering and massive servo systems, a new mode of operation has been defined known as streaming. In this mode of operation, the tape drive does not stop between blocks of data, as with classic large start/stop tape systems, but "streams" through the gap anticipating a new command from the Host before the next block is encountered. If a new command is not received before the end of the inter block gap, the drive will initiate a sequence called repositioning. In this reposition sequence, the drive will stop tape motion, back up to beyond the inter block gap, and stop again. By eliminating the necessity to stop the tape while remaining in the inter block gap, tape units capable of streaming operate at faster tape speeds with smaller, less costly motors and tape buffering methods.

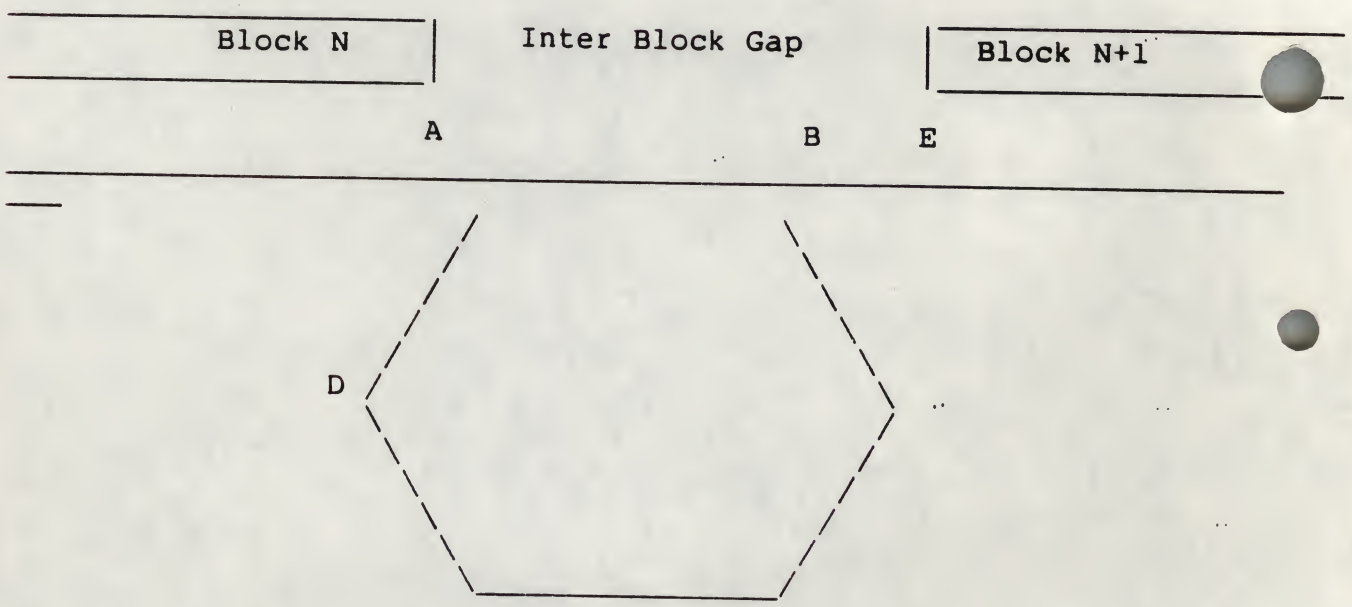


FIGURE 5-1. VELOCITY PROFILE FOR STREAMING MODE

Point A = End of Block N.
Point B = End of re-instruct window. Last point where a command can be received and motion maintained without a reposition.
Point D = End of reposition.
Point E = Beginning of BLOCK N+1

START/STOP OPERATION:

For higher performance than available on conventional streaming tape units such as heavy file access Host command sequences, the 9610/9660 has retained tension arms that allow true start/stop operation at 50 ips. In start/stop mode, at the end of each block, the drive will run a short distance into the gap then stop tape motion if no new command has been received from the host. Upon receiving a new command from the host, the drive will accelerate the tape back 50 ips and proceed to the next block without ever leaving the inter block gap.

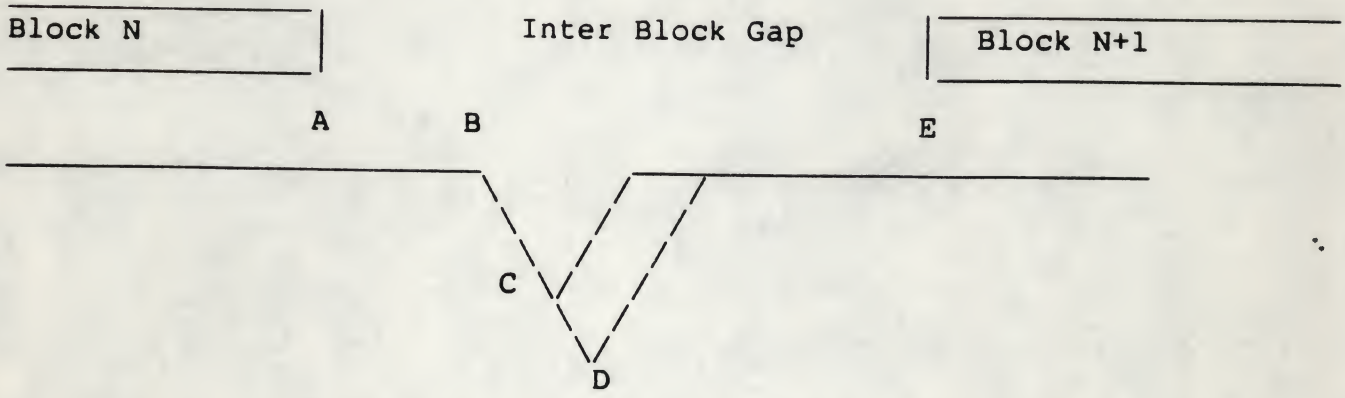


FIGURE 5-2. VELOCITY PROFILE FOR START/STOP MODE

Point A = End of BLOCK N.
Point B = End of re-instruct window. Last point where a
ny deceleracommand can be received and maintain motion without
Point C = Last point where a new command can be received
without requiring the drive to ramp to a full stop.
Point D = Stopped.
Point E = Beginning of BLOCK N+1.

NOMINAL DATA ACCESS TIME:

The nominal time required for the tape from a stopped position to accelerate, achieve nominal velocity and start the transfer of data.

(Points D to E in Figures 5-1 and 5-1.)

COMMAND REINSTRUCT TIME FOR ON-THE-FLY OPERATION:

The maximum latency from the drop of DBY to the reception of the next command for the drive to continue without stopping or repositioning.

(Points A to B in Figures 5-1 and 5-2)

MAXIMUM LATENCY FOR REINSTRUCTION ON THE RAMP (START/STOP MODE ONLY):

The 9610 will interrupt the deacceleration ramp in the start/stop mode and accelerate back to nominal velocity if a command is received early enough in the ramp.

(Points A to C in Figure 5-2)

REPOSITIONING TIME (STREAMING MODE ONLY):

The time required to execute a reposition sequence when operating in streaming mode.

(Points B to D in Figure 5-1)

5.3.2 TAPE SPEED

START/STOP	50 IPS
STREAMING	100 IPS
ADAPTIVE SPEED CONTROL	50/100 IPS
REWIND	200 IPS

TABLE 5-2 TAPE SPEED

5.3.3 NOMINAL DATA ACCESS TIME

		50 IPS	100 IPS
A) 800,1600,3200	READ	12.4 ms	20.6 ms
B) 6250	READ	16.4 ms	20.0 ms
C) 800,1600,3200	WRITE	8.6 ms	19.1 ms
D) 6250	WRITE	18.4 ms	18.2 ms

TABLE 5-3 NOMINAL DATA ACCESS TIME

5.3.4 COMMAND REINSTRUCT TIME WITH AUTOSPEED DISABLED

		50 IPS	100 IPS
A) 800,1600,3200	READ	0.7 ms	4.2 ms
B) 6250	READ	0.7 ms	2.0 ms
C) 800,1600,3200	WRITE	0.7 ms	3.8 ms
D) 6250	WRITE	3.0 ms	1.2 ms

TABLE 5-4 COMMAND REINSTRUCT TIME

5.3.5 MAXIMUM LATENCY FOR REINSTRUCTION ON THE RAMP

		50 IPS
A) 800,1600,3200	READ	3.2 ms
B) 6250	READ	2.9 ms
C) 800,1600,3200	WRITE	3.2 ms

5.3.6 TABLE 5-5 MAXIMUM LATENCY FOR REINSTRUCTION ON THE RAMP

5.3.7 REPOSITION TIME STREAMING MODE

	50 IPS	100 IPS
A) 800,1600,3200 READ		42.5 ms
B) 6250 READ		43.5 ms
C) 800,1600,3200 WRITE		42.5 ms
D) 6250 WRITE	35 ms	41.5 ms

5.3.8 TABLE 5-6 REPOSITION TIME STREAMING MODE

5.3.9 AUTO SPEED

The Models 9610/9660 features automatic speed selection to maximize the data throughput. If Auto Speed is selected as an option in the set-up mode, the unit will start operation from BOT at 50 ips. If three consecutive reinstruct times meet the nominal times below, the unit shall assume that the Host can maintain command reinstruct times at 100 ips operation. The unit shall then change tape speed from 50 ips to 100 ips in the IBG. Conversely, if the following command reinstructs fall outside the 100 ips reinstruct timing or the command completes, the unit returns to 50 ips operation.

A) 800,1600,3200 READ	2.8 ms
B) 6250 READ	1.5 ms
C) 800,1600,3200 WRITE	2.4 ms
D) 6250 WRITE	1.0 ms

5.3.10 TABLE 5-7 REINSTRUCT TIME LIMITS FOR AUTO SPEED TRANSITION TO 100 IPS

5.3.9 DATA TRANSFER RATE

	NOMINAL (AVERAGE OVER BLOCK)	MAX
AT 50 IPS		
NRZI	40 KB/SEC	48 KB/SEC
PE	80 KB/SEC	96 KB/SEC
DDPE	160 KB/SEC	192 KB/SEC
GCR	312.5 KB/SEC	375 KB/SEC

TABLE 5-8 DATA TRANSFER RATE AT 50 IPS

AT 100 IPS		
NRZI	80 KB/SEC	96 KB/SEC
PE	160 KB/SEC	192 KB/SEC
DDPE	320 KB/SEC	384 KB/SEC
GCR	625 KB/SEC	760 KB/SEC

TABLE 5-9 DATA TRANSFER RATE AT 100 IPS

5.3.11 SPEED VARIATION

INSTANTANEOUS	+/-3%
LONG TERM	+/-1%

5.4 TAPE DETECTORS

BOT/EOT	INFRARED
BROKEN TAPE	INFRARED

5.5 AUTO LOAD

SUCCESSFUL AUTO LOAD RATE: 95% of load attempts for all reel sizes.

NOTE: The tape end should be unmarred and have no folds. Environmental specifications for Operational Conditions must be maintained.

5.6 TAPE ACCESS

Tape access is through the front panel access door. Tape insertion is achieved by lowering the front door and sliding the tape into the access slot.

If tape is in a LOADED condition, the front access door shall be locked. The door is unlocked when power is off or tape is in an UNLOADED condition. A mechanical release can be accessed from the front door inside the tape slot that will allow the user to release the reel from the hub in case of unit or power failure.

6. DATA RELIABILITY

6.1 WRITE/READ RELIABILITY DEFINITIONS

The following definitions are necessary to fully understand the level of performance to expect from the Kennedy models 9610/9660 and to properly compare competitive products. To properly define what is and isn't included in the reliability numbers makes those numbers meaningful.

6.1.1 WRITE RELIABILITY DEFINITIONS

The following errors may be considered write errors if they occur during a write operation:

NRZI - LRC, CRC, or vertical parity errors

PE & DDPE - One or more tracks in error, or a parity error without any tracks in error.

GCR - ACRC, CRC, or two or more tracks in error.

A write error must be rewritten with a new area of tape of tape erased between each retry. The block must also be written within ten rewrites of the original error block.

Errors attributable to tape defects during writing or rewriting are not considered to be write errors. A tape defect is an area of magnetic tape that will cause at least one write error in each of ten attempts to rewrite a block in the area on tape where the block was initially written. The magnetic tape media used for write error determinations shall meet the requirements of ANSI X3.40-1976.

Errors not attributable to tape defects (i.e., the write was attempted on a section of known good tape) and not rewritable in ten cycle retries are considered failures.

Note: Single track error correction shall be invoked during GCR write.

6.1.2 READ RELIABILITY DEFINITIONS

The following overview shall interpret the definitions on which read reliability is specified for the Model.

6.1.2.1 TYPE OF READ ERRORS

Read error rates are specified for two possible types of read errors. The specified error rates do not include errors which are attributable to foreign particles, oxide or tape damage, or malfunctioning equipment.

The most serious type of error is the "Permanent Error" or "Unrecoverable Error", which is a bad block on tape which cannot be read correctly either in Forward or Reverse Read within 10 retries.

The more common type of error is the "Soft Error" or "Temporary Error", which is an error which can be recovered either in Forward or Reverse Read before ten retries are completed.

6.1.2.2 CORRECTED ERROR

In GCR, PE and DDPE, it is possible to define a third type of error known as a corrected error or CER. For the purposes of this specification CER's or corrected errors are not counted as part of the data reliability figures.

GCR provides powerful means for error correction, and also offers independent verification of correct data transmission by providing both CRC and ACRC generation. Therefore, most errors in GCR can be corrected "on-the-fly" and used by the host without necessitating a retry. GCR corrected errors should have absolutely no impact on either system throughput or effective data reliability. The unit optionally allows GCR corrected error reporting to be disabled to the host, to guarantee that retries will not be attempted.

PE and DDPE also perform an "on-the-fly" error correction employing simple parity generation; this process is flagged to the host as a CER. Because the PE and DDPE formats do not support independent error checking such as CRC or ACRC, some users may prefer to retry a read operation when a PE or DDPE "corrected error" is reported to the host.

6.2 WRITE/READ RELIABILITY SPECIFICATION

	READ		
	(1) READ RECOVERABLE	(2) READ PERMANENT	(3) WRITE
NRZI	1 IN 10^8 BYTES	1 IN 10^8 BYTES	1 IN 10^7 BYTES
PE	1 IN 10^9 BYTES	1 IN 10^{10} BYTES	1 IN 10^8 BYTES
GCR	1 IN 10^{10} BYTES	1 IN 10^{11} BYTES	1 IN 10^7 BYTES

1. Soft or Temporary errors not attributed to tape defects, and not including CER's.

2. Permanent or Unrecoverable error with on-th-fly error correction, 10 retries and not including CER's.

3. a) Write errors reported to the host, as defined above.

   b) Errors attributed to tape defects are not considered write errors. A tape defect is an area of tape that causes at least one write error in 10 attempts to rewrite a block in that area of tape.

6. DATA RELIABILITY

7. PRODUCT RELIABILITY

7.1 GENERAL

The following reliability data are valid when the product is used within the parameters of this specification.

7.2 MEAN TIME BETWEEN FAILURE (MTBF)

The calculated MTBF figure for the Model 9610/9660 is 7,000 hours at a 20% duty cycle. The actual measured MTBF will be achieved within 18 months of product release.

All reliability figures are based on a mature product. Minimum guaranteed figures for Product Reliability built during the first 18 months of production would be reduced slightly as shown in the following schedule:

1ST THROUGH 9TH MONTH	**80% OF MTBF SPECIFICATION**
10TH THROUGH 18TH MONTH	**90% OF MTBF SPECIFICATION**

7.3 MAGNETIC HEAD ASSEMBLY

SURFACE	HARD COATED
NUMBER OF TRACKS	9 TRACKS READ AFTER WRITE
TAPE CLEANER	DUAL SAPPHIRE
HEAD LIFE	RATED AT 5000 HOURS

7.4 PRODUCT LIFE

The life expectancy of the Model 9610/9660 is the period of time for which the product will meet its specified performance and reliability, provided that routine maintenance is carried out as and when specified.

Product life, for which the standard service parameters are valid, is estimated to be seven (7) years based on a 20% duty cycle. The 20% duty cycle is the basis for all service maintenance and mean time figures. Duty cycle is defined as:

$$\text{DUTY CYCLE} = \frac{\text{total accumulated tape motion}}{\text{total power on time}}$$

FIGURE 7-1 DUTY CYCLE CALCULATION

NOTE: Seven years at 20% duty cycle is established with 16 hours a day 5 day week or 260 days a year.

Within the designed life assuming an average duty cycle of 20%, the magnetic head will need scheduled replacement after 5,000 hours of tape motion.

7.5 MEAN TIME TO REPAIR (MTTR)

The Model 9610/9660 architecture is modularized. The resident diagnostic exerciser enhances module isolation. All modules can be quickly accessed and replaced. All interconnecting wiring harnesses have connectors for removal and installation. There are no electrical adjustments on any of the modules.

The modular construction and the diagnostics which isolate failures to specific modules result in a MTTR of less than 30 minutes.

8. PHYSICAL OUTLINES

8.1 WEIGHT

9610 RACK MOUNT	115 pounds (52 kg)
9660 STAND ALONE CABINET	145 pounds (66 kg)

8.2 SIZE

8.2.1 9610 - RACK MOUNT

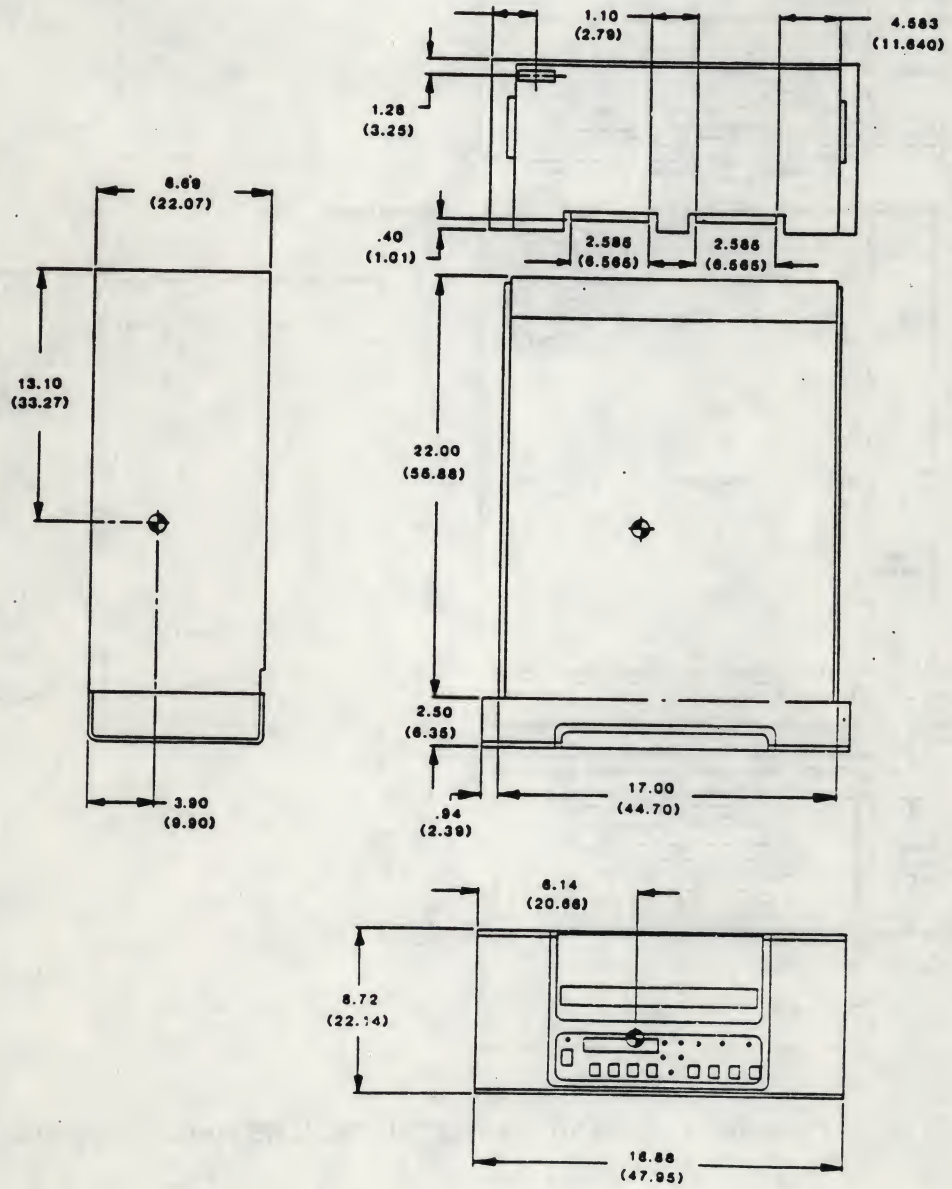


FIGURE 8-1 9610 PHYSICAL DIMENSIONS

8.2.2 9660 - STAND ALONE CABINET

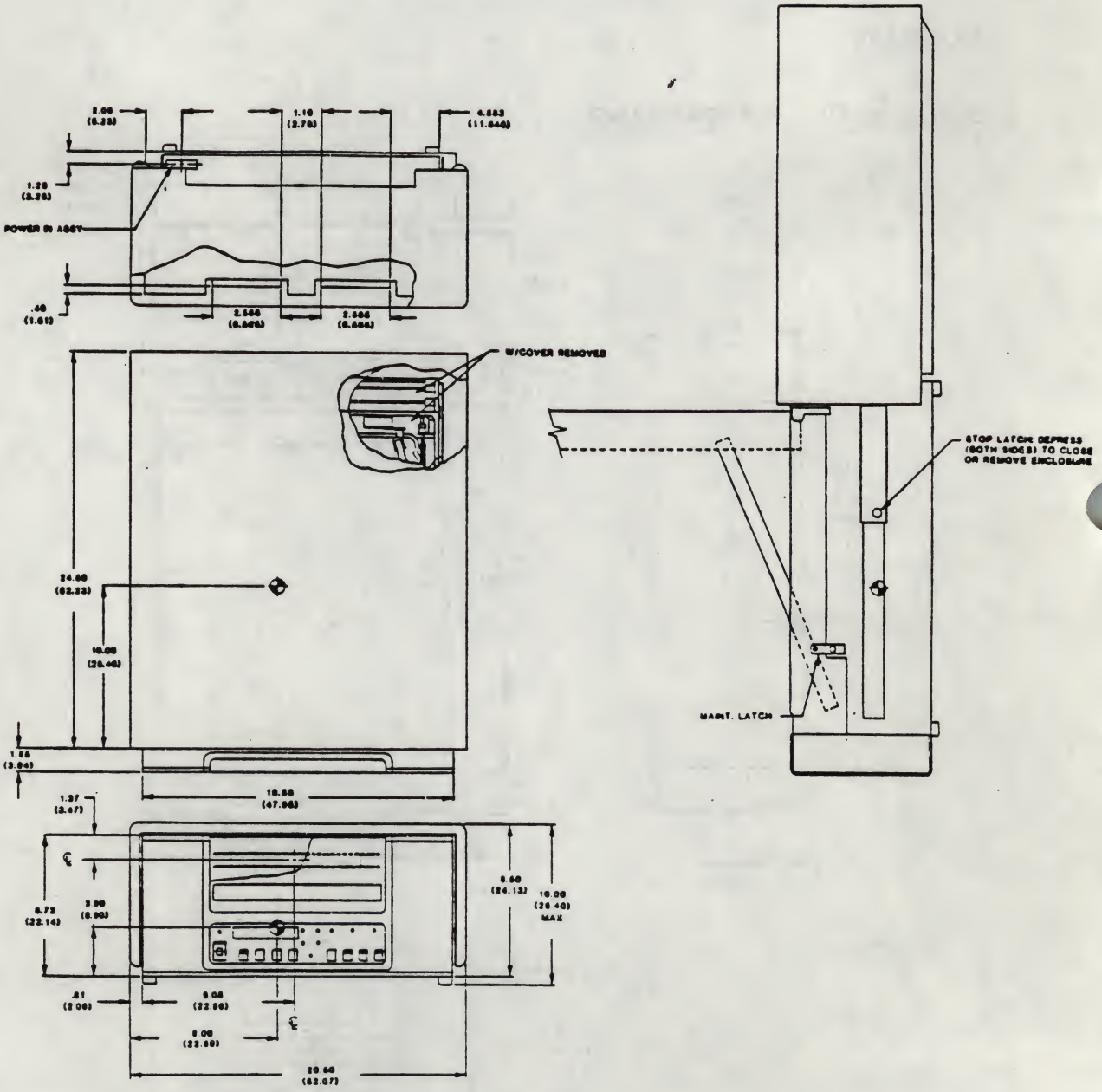


FIGURE 8-2 9660 PHYSICAL DIMENSIONS - STAND ALONE

9. POWER REQUIREMENTS

9.1 VOLTAGE SELECTION

AC voltage and frequency selection is accomplished by inserting a small voltage selection card at the rear of the unit.

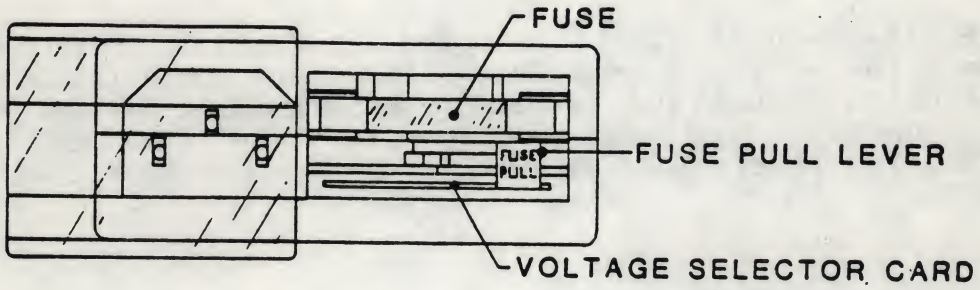


FIGURE 9-1 VOLTAGE SELECTION

9.2 POWER SPECIFICATIONS

VOLTAGE	100, 120, 220, 240 VAC +15% -10%
FREQUENCIES	50 OR 60 HZ +/-2 HZ

CURRENT	**120 VAC**	**220 VAC**
NOMINAL	2.3 AMPS	1.2 AMPS
PEAK INRUSH	25 AMPS/17 MSEC	13 AMPS/17 MSEC.

POWER	**120 VAC**	**220 VAC**
NOMINAL	300 WATTS	300 WATTS
PEAK	400 WATTS	400 WATTS

FUSING	**100/120 VAC**	**220/240 VAC**
RATING	6 AMP SLO	3 AMP SLO

The standard 9610 is shipped configured for 120 VAC operation. The 6 amp fuse is in the receptacle/voltage selection module and is easily accessible from the rear of the unit. A 3 amp replacement fuse for 220/240 VAC operation is provided as part of the accessory kit with each unit.

10. ENVIRONMENTAL SPECIFICATIONS

10.1 GENERAL ENVIRONMENTAL SPECIFICATION

The following environmental specifications must be maintained to guarantee that the unit shall meet all performance specifications. The product warranty is valid only under the following conditions:

10.1.1 OPERATING ENVIRONMENT

The operating environment is limited to and controlled by the operating environmental requirements of the magnetic tape media as specified in ANSI X3.40-1983.

The unit can operate without damage at 104° F (40° C) for 2 hours at a 78° F wet bulb temperature. However, due to tape media limitations data reliability cannot be guaranteed above 90° F (32° C) at a 78° F wet bulb temperature.

10.1.1.1 PREFERRED OPERATING TEMPERATURE

+60° F to +90° F (+15.6° C to +32.2° C)

10.1.1.2 OPERATING RELATIVE HUMIDITY

20% to 80% (non-condensing) +78° F wet bulb temperature

10.1.1.3 OPERATING ALTITUDE

-1,300 to 10,000 feet (-400 to 3,000 meters)

10.1.2 STORAGE ENVIRONMENT (NON-OPERATING)

10.1.2.1 STORAGE TEMPERATURE

-40° F to +122° F (-40.0° C to +50.0° C)

10.1.2.2 STORAGE RELATIVE HUMIDITY

5% to 90% (non-condensing) +83° F wet bulb temperature

10.1.2.3 STORAGE ALTITUDE

-1,300 to 10,000 feet (-400 to 3,000 meters)

10.1.3 SHIPPING ENVIRONMENT

10.1.3.1 SHIPPING TEMPERATURE

-40° F to +160° F (-40.0° C to +71.0° C)

10.1.3.2 SHIPPING RELATIVE HUMIDITY

5% to 95% (non-condensing)

10.1.3.3 SHIPPING ALTITUDE

-1,300 to 40,000 feet (-400 to 19,000 meters)

10.2 THERMAL PARAMETERS

10.2.1 AIR FLOW REQUIREMENTS

The total airflow into the unit is approximately 70% fresh air entering from the front panel and the remaining 30% from air within the cabinet. 30 cfm is exhausted at the rear and rear right side of the drive. The cabinet should have sufficient exhaust to ensure that the cabinet temperature remains below 90° F (32° C).

It is recommended that a one inch clearance be left between the top and bottom of the unit and other devices to ensure sufficient air flow and prevent excessive conducted heat from neighboring devices.

10.2.2 HEAT DISSIPATION

TOTAL HEAT DISSIPATION 1025 BTU/HR

10.3 ACOUSTIC NOISE LEVEL

NORMAL RUNNING

Operator Position	NC-55
Bystander Position	NC-50

TAPE THREADING

Operator Position	NC-65
Bystander Position	NC-65

10.4 SHOCK AND VIBRATION

10.4.1 SHOCK

OPERATING

3G, 11 milliseconds, 1/2 sine wave, 3 axis.

NON-OPERATING

4G, 15 milliseconds, 1/2 sine wave, 3 axis

10.4.2 VIBRATION

OPERATING

0.01" double amplitude from 5 - 22 Hz and
0.25g from 22 - 500 Hz, 3 AXIS

NON-OPERATING

0.01" double amplitude from 5 - 10 Hz and
0.50g from 10 - 500 Hz, 3 AXIS

PACKAGED FOR SHIPPING

0.25" double amplitude from 5 - 11 Hz,and
1.50g from 11 - 200 Hz, 3 AXIS

8" Drop in Carton

10.5 ELECTROSTATIC AND DISCHARGE SPECIFICATION

The Models 9610/9660 are designed to withstand electrostatic shock to operator access areas as stated in the following table. Normal ESD protection and care should be exercised however, when removing any pcba from the unit or during handling. The unit shall be standing alone uncabled and running on internal diagnostics

ESD AMPLITUDE	EFFECT
LESS THAN 7 KV	NO EFFECT
OVER 7 KV TO 12 KV	SOFT ERRORS
OVER 12 KV TO 17 kv	HARD ERRORS DATA CORRUPTION PROGRAM MALFUNCTION
OVER 17 KV TO 25 KV	LOSS OF EEPROM DATA
OVER 25 KV	COMPONENT FAILURE

10. ENVIRONMENTAL SPECIFICATIONS

11. REGULATORY AND AGENCY APPROVAL

11.1 REGULATORY AND SAFETY COMPLIANCE

The Model 9610/9660 meets all the following regulatory and safety standards.

11.1.1 U. L., INC. STANDARD 478

The 9610 and 9660 were investigated under the Standard for Information Processing and Business Equipment, UL 478 5th edition. The 9610 is a UL Recognized Component and the 9660 is a UL Listed Unit.

11.1.2 FEDERAL COMMUNICATIONS COMMISSION

The Model 9610 and the 9660 have been verified to meet Code of Federal Regulations 47, Part 15, Subpart J, Class A requirements when tested with shielded data cables as free-standing units.

11.1.3 CANADIAN STANDARDS ASSOCIATION

The Models 9610 and 9660 were investigated under CSA Standard C22.0 No. 154-M1983. The 9610 is CSA Certified as a component for use in other equipment where the suitability of the combination is to be determined by the Canadian Standards Association. The 9660 is CSA Certified as a stand-alone unit.

11.1.4 VDE SAFETY AND IEC

The Models 9610 and 9660 were investigated and certified by TUV Rheinland to DIN IEC 380/VDE 0806/08.81 STD. These are accepted equivalent International (IEC) and German (VDE) product safety standards.

11.2 ANSI COMPATIBILITY

The Model 9610/9660 complies with the follcwing ANSI specifications:

ANSI X3.22	Recorded Magnetic Tape for Information Interchange (800 cpi, NRZI)
ANSI X3.39-1986	Recorded Magnetic Tape for Information Interchange (1600 cpi, PE)
ANSI X3B5/85-194-A	Recorded Magnetic Tape for Information Interchange (3200 cpi, DDPE)
ANSI X3B5/85-156	Recorded Magnetic Tape for Information Interchange (6250 cpi, GCR)

12. CONTROL PANEL, DIAGNOSTICS, AIDS AND OPTIONS

12.1 CONTROL PANEL OPERATION

12.1.1 PANEL CONTROLS AND INDICATORS

REFERENCE FIGURE 7-1 FOR CROSS REFERENCE

(1) Tape Access Door:
Entrance door for insertion of tape reel.

(2) Character Display Readout:
Displays operating mode, status, parameters, and diagnostic messages.

(3) Power LED (unmarked, in power switch):
Illuminates when power to drive is ON.

(4) ON/OFF Switch:
Controls ac power to Drive.

(5) DIAG Pushbutton:
Turns diagnostics ON and OFF when Drive is off-line. Key depression traverses diagnostic menu and internal LED illuminates in the diagnostics mode.

(6) SCAN Pushbutton:
Scans diagnostics and calibrate menus.

(7) ENTER Pushbutton:
Enters selected commands in diagnostics or calibrate mode.

(8) START/STOP Pushbutton:
Starts or stops selected commands in the diagnostics or calibrate mode.

(9) REMOTE DEN LED:
Illuminates when density is selectable by Host or automatically when reading off loadpoint. LEDs 800, 1600, 3200, and 6250 indicate selected density.

(10) DENSITY Pushbutton:
Selects data density remote or local mode(800, 1600, 3200, 6250).

(11) ON-LINE Pushbutton:
Illuminates when Drive is ON-LINE.

(12) LOAD Pushbutton:
Initiates Load sequence.

(13) RWND/UNL Pushbutton:
Initiates Rewind or Unload when Drive is Off-line. If tape is not at loadpoint, pressing this button will rewind the tape. If the tape is at loadpoint, pressing this button will unload the tape and unlock the access door.

(14) WRITE ENABL LED:
Illuminates when supply reel is not write protected.

(15) LOAD PT LED:
Illuminates when tape is at Load Point.

(16) SELECT LED:
Illuminates when Drive is selected by the Host.

FIGURE 12-1 9610 FRONT PANEL

12.1.2 DISPLAY - ON-LINE OPERATION

12.1.2.1 LOAD OPERATION

If the door is left open when a Load operation has been selected, the display will flash **">CLOSE"** then **"DOOR<"** repeatedly until the door is closed or the Unload pushbutton is pressed.

If the reel of tape is inserted upside down, the unit will abort the load sequence, unlock the hub, and display **"REV REEL"**.

If a tape loads in the tape path, but BOT is not detected the front panel will display **"BOT ?"** and the load will abort.

If a load is attempted without a reel in the drive unit the front panel will display **"PLC REEL"** (place reel) and the load will abort.

If, during a load, the hub rotates more than one revolution while attempting to lock the reel onto the hub, the front panel will display **"CHK SLND"** (check solenoid) and the load will abort.

If the hub locked sensor fails to indicate a locked hub during the load sequence the front panel will display **"CHK HUB"** (Check Hub) and the load will abort.

If the Drive fails to successfully load a tape within four attempts, the load operation will be aborted and the front panel will display **"ABORTED"**. The REWIND/UNLOAD LED will flash.

12.1.2.2 Tape Motion Operation

When the unit is performing online operations the "UNIT #" shall be displayed.

When the unit is rewinding, "RWINDING" shall be displayed.

While the unit is loading, "LOADING" shall be displayed.

12.2 POWER UP FUNCTIONAL TEST

Each time power is supplied to the drive, the internal functional tests will exercise the unit in the following areas.

1. Drive Electronics including:

a) Power supply voltage test.
b) Drive Electronics PCBA test.
c) Check front panel.
d) Check servo system including reel and capstan motors.

26. Formatter Electronics including:

a) Formatter processor board test.
b) Analog Write/Read test in GCR density.
c) Digital Write to Read loop.

The unit display will indicate **"TESTING"** during the functional test process and then the unit select number when the test is complete. If the drive fails the power up functional test, the display will indicate either the failed module or a failure code.

The following sections detail the tests and status reporting

12.2.1 DRIVE ELECTRONICS SECTION

Upon power-up, the drive electronics exercises and checks the following:

a) Checksum of the Drive Electronics Program Prom:

If the checksum of the PROM is not zero, it will display "ROM ?" and halt.

b) Power supplies:

If +12V supply falls below 10V, it will display "+12V ?"
If +40V supply falls below 30V, it will display "+40V ?"
If -12V supply falls below -7V, it will display "-12V ?"
If -40V supply falls below -29V it will display "-40V ?"

c) If the formatter section of the unit does not interrogate the drive electronics within 2.5 sec or if the formatter does not send drive ID one second after ID request from the drive, the unit will display **"FMT ERR?"** and flash the REW LED.

d) If the buffer arms cannot be calibrated, functional test will display **"TAK ARM?"** or **"SUP ARM?"** to indicate a take-up buffer arm or supply buffer arm problem.

e) If no tachometer lines are detected when the capstan motor is rotated, functional test will display **"CAPSTAN?"**. The problem may be in the capstan motor, the capstan power amplifier, or the tachometer.

f) When the take-up reel motor or supply reel motor is driven, the corresponding **"MOVING"** signal should be detected. If not, the unit will display **"T MOTOR?"** or **"S MOTOR?"** to indicate a take-up reel or supply reel motor problem.

g) The drive electronics EEPROM checksum is computed. If a non-zero checksum is detected, the unit will display **"EEPROM ?"** and will flash the "REW" LED. If the **"RWND/UNL"** button is pressed, functional test will compute the new checksum and try to write it to the EEPROM.

12.2.2 FORMATTER ELECTRONICS SECTION

The power-up functional test checks the operational health of the electronics. The checks are purely functional giving failure codes to identify where in the circuit the probable failure occurred associated with formatter electronics.

The following formatter electronics section checks are performed:

a) Micro-processor sanity check.

b) Micro-processor RAM check.

c) External RAM check, data pattern 55h.

d) External RAM check, data pattern AAh.

e) External RAM check, addressing.

f) ID the formatter.

g) Send test amp gain values to the analog board.

h) Loop write to read digital, 50 ips NRZI.

i) Loop write to read digital, 100 ips NRZI.

h) Loop write to read digital, 50 ips PE.

j) Loop write to read digital, 100 ips PE.

k) Loop write to read digital, 50 ips DDPE.

l) Loop write to read digital, 100 ips DDPE.

m) Loop write to read digital, 50 ips GCR.

n) Loop write to read digital, 100 ips GCR.

o) Loop write to read analog, 50 ips GCR.

a) Drive section response to Request Status command.

12.2.3 DISPLAY - FAILURE CODES

CODE	NOTE	DESCRIPTION	PROBABLE SECTION
128		External RAM data ERROR	COMPARE RAM, 7951
129		External RAM addressing ERROR	COMPARE RAM, 7951
131		No RBSY for AMP VALUES	READ ANALOG BOARD
132		Wrong Formatter board for 9610	FORMATTER
133		Wrong Analog board for 9610	READ ANALOG BOARD
134		Wrong Digital board for 9610	DIGITAL BOARD
140	(1)	AUTO ADJUST ranging ERROR	READ ANALOG BOARD
141	(1)	DEAD TRACK found in AUTO ADJUST	READ ANALOG BOARD
142	(1)	OVER RANGE SIGNAL in AUTO ADJUST	READ ANALOG BOARD
150	(2)	No RBSY in LOOP RAW TEST	SEE BELOW
151	(2)	No WBSY in LOOP RAW TEST	SEE BELOW
152	(2)	TIME-OUT on WBSY in LOOP RAW TEST	SEE BELOW
153	(2)	TIME-OUT on RBSY in LOOP RAW TEST	SEE BELOW
154	(2)	WBSY ended too soon in LOOP TEST	SEE BELOW
155	(2)	HARD ERROR in LOOP TEST	SEE BELOW
156	(2)	CORRECTED ERROR in LOOP TEST	SEE BELOW
157	(2)	COMPARE ERROR in LOOP TEST	SEE BELOW
158	(2)	FILE MARK during LOOP TEST	SEE BELOW
159	(2)	Block size ERROR in LOOP TEST	SEE BELOW

TABLE 12-1. DISPLAY FAILURE CODES

a) Press the density button to display suspected bad channel.

b) Press the density button to get more information:

D-50 NRZ	LOOP WRT/RD	DIGITAL	50	IPS	NRZI	READ/WRITE DIGITAL
D-100NRZ	LOOP WRT/RD	DIGITAL	100	IPS	NRZI	READ/WRITE DIGITAL
D-50 PE	LOOP WRT/RD	DIGITAL	50	IPS	PE	READ/WRITE DIGITAL
D-100 PE	LOOP WRT/RD	DIGITAL	100	IPS	PE	READ/WRITE DIGITAL
D-50 DDPE	LOOP WRT/RD	DIGITAL	50	IPS	DDPE	READ/WRITE DIGITAL
D-100DDPE	LOOP WRT/RD	DIGITAL	100	IPS	DDPE	READ/WRITE DIGITAL
D-50 GCR	LOOP WRT/RD	DIGITAL	50	IPS	GCR	READ/WRITE DIGITAL
D-100GCR	LOOP WRT/RD	DIGITAL	100	IPS	GCR	READ/WRITE DIGITAL
A-50 GCR	LOOP WRT/RD	ANALOG	50	IPS	GCR	READ/WRITE ANALOG

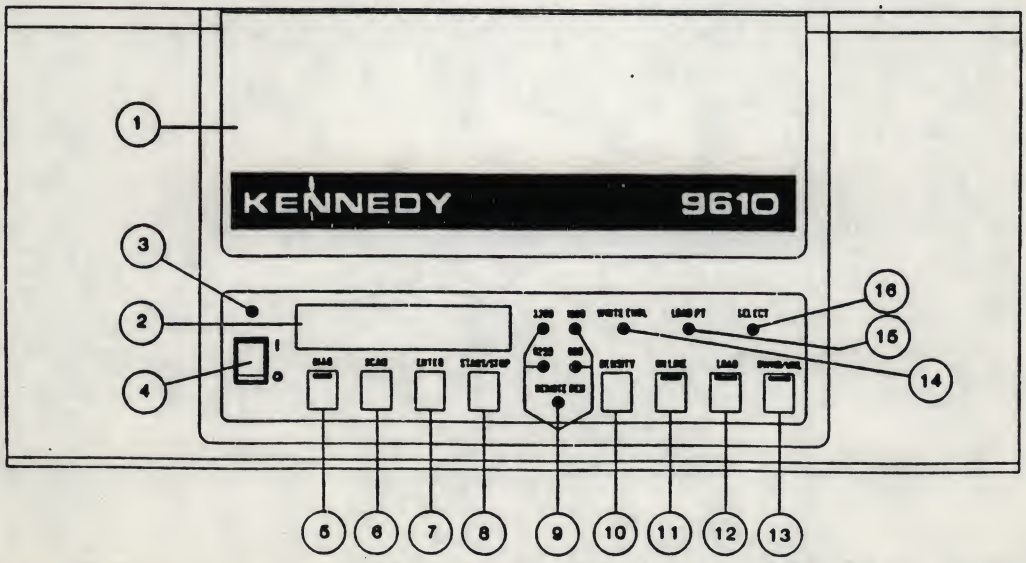
.t.TABLE 12-2.FAILURE QUALIFIER

(displayed for failure code 150 - 159)

12.3 DIAGNOSTIC TESTING

Special diagnostic tests can be accessed via the front panel diagnostic switches. Furthermore, a complete tape exerciser is embedded in the diagnostic structure including the storage and reporting of the type and quantity of errors.

The user can select a group of tests in order to evaluate the unit's performance off line or to review errors that occurred on line. These modes are entered by depressing the DIAG mode switch (5) and then successively rippling through the SCAN (6) and Enter (7) switches. Pressing the START/STOP (8) will cycle to the selected function. This section will describe the tests available. Included in each section is the alphanumeric display readout associated with the particular section.



12.3.1 MOTION TESTS

The following motion tests are available in the diagnostic mode:

50 FWD	FORWARD ON-THE-FLY AT 50 IPS
50 REV	REVERSE ON-THE-FLY AT 50 IPS
50 FSS	FORWARD START/STOP AT 50 IPS
50 RSS	REVERSE START/STOP AT 50 IPS
50 FRF	FORWARD/REVERSE/FORWARD AT 50 IPS
100 FWD	FORWARD STREAMING AT 100 IPS
100 REV	REVERSE STREAMING AT 100 IPS
100 FSS	FORWARD REPOSITIONING AT 100 IPS
100 RSS	REVERSE REPOSITIONING AT 100 IPS
100FRF	FORWARD/REVERSE/FORWARD AT 100 IPS
50/100 F	ALTERNATE 50/100 IPS FORWARD
50/100 R	ALTERNATE 50/100 IPS REVERSE
BURN IN	CONTINUOUS TESTING IN FORWARD DIRECTION WITH REWIND AT EOT

Display - Motion Tests

MOTION => 50 FWD, 50 REV, 50 FSS, 50 RSS, 50 FRF, 100 FWD, 100 REV, 100 FSS, 100 RSS, 100 FRF, 50/100 F, 50/100 R, BURN IN.

12.3.2 EXERCISER FUNCTIONS (DATADIAG)

12.3.2.1 Data Diagnostic Overview

The internal data diagnostic functions of the unit are designed to aid in a quick and thorough evaluation of the operation of the complete system. There are three sub-menus in the DATADIAG menu:

MODE: Allows the user to set operating parameters.
COMMANDS: Execution of the various functions.
ERRORS: Status of the execution.

12.3.2.2 MODE Selection of Operating Parameters

To make changes, scan to the desired parameter and press the ENTER key. The first option displayed is the current setting. To change it press SCAN until the desired setting is displayed, then press ENTER. Use the DENSITY key to select format.

a) ON ERROR:
Select response to a data error, either CONTINUE or STOP. Default is CONTINUE.

b) AT EOT:
Select action to be invoked at end-of-tape, either REWIND or STOP. Default is REWIND.

c) BLK SIZE:
Select the block size to write and read. Choices are: 4, 256, 513, or 1024. Default is 4 bytes.

d) DATA:
Create a data pattern for a write process and to perform a read compare operation. SCAN to the desired data pattern and use the enter key to load the data RAM. If a special pattern is desired, it can be loaded by placing the drive ONLINE, and issuing a write command. The last 1024 bytes of the write data will remain in the data RAM. If this is done it will be signified by the choice, USER, upon entering the data pattern selection menu. Other choices are: ALL ONES, ALL ZEROS, INCREMENTING, RANDOM, ALTERNATING 00-FF.

e) SPEED:
Operating speed selection: 50 IPS or 100 IPS.

f) RE-INST:
Re-instruction point. If selection is STREAM, the commands will be re-issued on-the-fly. If START/STOP, the drive will stop between commands. If SINGLE is selected, the drive will execute the selected command or sequence once each time the START/STOP switch is pressed. Default is STREAM.

Display - MODE Selection of Operating Parameters

```
DATADIAG=>      MODE =>  ON ERROR    => CONTINUE, STOP
                         AT EOT      => REWIND, STOP
                         BLK SIZE    => 4, 256, 513, 1024
                DATA =>  ALL ONES, ALL ZERO
                         INCREMENT, RANDOM
                         ALT 0-FF
                SPEED => 50 IPS, 100 IPS
                RE-INST=> STREAM, START/STOP
                         SINGLE
```

12.3.2.3 COMMAND Execution

Execution is equivalent to a command generated by the host interface except as noted. Start a function by pressing START/STOP. The command or sequence will run until the START/STOP key is depressed, unless the selection is in SINGLE step mode. If the drive runs away due to some catastrophic failure, pressing the DIAG will force a hard stop but tape position will be lost.

a) LOOP DIG:
Same as a WRITE command except the data is looped back from the write section to the read digital section. Tape need not be loaded to execute this command.

b) LOOP ALG:
Same as a WRITE command except the data is looped back from the write section through the analog section passing through all of the read electronics except the head and the pre-amp. Tape need not be loaded to execute this command. This command will only be executed in the GCR density at 50 ips.

c) WRITE:
Write data onto the tape as specified by the current MODE parameters. If a write command is issued from diagnostics on a write protected tape the front panel will display "CAN'T WR".

d) WRT W/RE:
Same as a WRITE command except a retry sequence will be initiated if an error is detected. The retry sequence consists of a backspace command, followed by a fixed length erase command before rewriting the block.

e) READ:
Read data from the tape in the forward direction comparing it to the selected pattern.

f) READ REV:
Read data from the tape in the reverse direction. No comparison is performed.

g) READ/RR:
Alternately read and read reverse as described earlier. If the previous command was a reverse direction command, a read will be issued first, otherwise a read reverse will be executed first.

h) FMK TEST:
Write a file mark and check for file mark status from the read section.

i) WRT/WFMK:
Write a block and then a file mark.

j) WR/RR/RD:
Execute the sequence: WRITE, READ REVERSE, then READ. Each command is executed as described above.

Display - COMMAND Execution

DATADIAG=> COMMANDS => LOOP DIG, LOOP ALG, WRITE, WRT W/RE, READ, RD REV, RD/RR, FMK EST, WRT/WFMK, WR/RR/RD

12.3.2.4 ERROR Reporting

As each command is executed a log is kept of the errors found. Use the SCAN key to show the error logs without clearing the accumulated counts. Use the ENTER key to clear a log and go on to the next log entry. A count of OVR signifies an over-flow of the 8 bit counter. The error log will accumulate errors on commands received from the host as well as in DATADIAG mode to aide in system troubleshooting.

a) EIC0:
ERROR IN CHANNEL 0 through 7 and Parity. Accumulated through the total of hard errors, corrected errors, and soft pointers sorted by individual channels.

b) WPAR:
WRITE PARITY errors. Hard errors flagged because of a detected parity error on the write data bus from the Host.

c) CMP:
COMPARE errors. Data returned by the read section does not compare with the data sent to the write section during a write command; or, data read does not match the pattern selected on diagnostic read commands.

d) HER:
HARD ERROR flagged by the read section.

e) STE:
SINGLE TRACK ERROR. Single track corrected error in GCR or any corrected error in PE or DDPE.

f) DTE:
DOUBLE TRACK ERROR reported and corrected in GCR.

g) FMK:
FILE MARK error. File mark status was not returned following write file mark command.

Display - ERROR Reporting

```
DATADIAG=>ERRORS  => EIC0 xxx, EIC1 xxx, EIC2 xxx, EIC3 xxx,
                     EIC4 xxx, EIC5 xxx, EIC6 xxx, EIC7 xxx, EICP xxx,
                     WPAR xxx,  CMP xxx,  HER xxx,  STE xxx,
                      DTE xxx,  FMK xxx
```

12.4 AIDS AND OPTIONS

Automatic calibration of read amplitudes and write current are possible. Testing of the tape-in-place sensor and buffer arm sensor adjustment is also included.

12.4.1 CALIBRATION AIDS

Manual and automatic read gain adjustments of all densities at both tape speeds can be made. Manual values are entered via the front panel switches. For example, the manual entry mode for read amp gain allows at one level, (RANGE X), the overall adjustment of all nine channels simultaneously; then the next level down (AMPN X) allows adjustment of the individual gains of the nine read amplifiers

Display - Calibration

```
CAL      =>  AUTO      =>  ALL,                    => CONFIRM?
                           NRZI, PE, DDPE, GCR,  => 50 IPS,
                                                   100 IPS => CONFIRM?

                           WRT CURR              => CONFIRM?

MANUAL       =>NRZI,PE,    => 50 IPS,
               DDPE GCR       100 IPS => CONFIRM? =>
                                                    RANGE X
                                                    AMPN X
```

12.4.2 MECHANICAL ADJUSTMENT AIDS

The drive automatically adjusts the gains of the buffer arm sensors at power up.

In the **DRIVE ADJUST** mode the user can set the relationship of the buffer arms to the buffer arm sensor. With the replacement of a buffer tape arm, service personnel need only to set the arm/sensor relationship when re-installing the buffer arm. The display will indicate the error voltage during the adjustment.

Also available is Hub Sense to test and align the reel-in-place sensor.

DISPLAY - Adjustments

```
DRV ADJ =>  BUF ARMS, =>  TAKE X.X, SUPP X.X
            HUB SENS  =>  NOT IN, IN PLACE
```

12.4.3 USER SELECTABLE OPTIONS FOR UNIT SETUP

User selectable options are available from the operator panel. They can be accessed by selecting the SET UP mode in the diagnostics.

12.4.3.1 UNIT SELECT NUMBER

The Unit Select number for each drive can be entered from 0 to 7. It is recommended that if a single drive is used that drive 0 be employed.

12.4.3.2 DEFAULT DENSITY

The density that is to be displayed at power on can be chosen from a menu by the user including local or remote.

12.4.3.3 SPEED

There are four speed selection choices available to the user.

HOST SELECT: HOST SEL:
Allows the controller to select speed. Default speed is 50 ips.

AUTOSPEED: AUTO
The drive will select the speed based on the host reinstruct time.
The controller can override **AUTOSPEED** and force the unit to 100 ips.

50 IPS:
Drive will run at 50 ips only.

100 IPS:
Drive will run at 100 ips only regardless of repositioning.

12.4.3.4 TIME OUT

This feature prevents the tape from running off the end of tape; e.g. no block of data is encountered in Read for a period equal to 25 feet of tape passing over the tape head. The unit shall halt with no RSTR's and report a Hard Error. Applications which require block lengths is excess of 25 feet can disable this option.

12.4.3.5 SECURITY ERASE

The interface command for Security Erase can be disabled by users of critical data. Security Erase will erase the tape, from the point of command acceptance to 3 feet past EOT. Removing the Write Enable Ring would also prevent critical data from being erased on specific reels.

12.4.3.6 INTERFACE PARITY CHECK

A choice is available to the user to test or not test the parity of write data issued by the Host. It is recommended that if data parity is available from the host, it should be tested for maximum reliability. Errors occurring as a result of this test will cause HER to be sent to the Host and the WPAR count to increment in the error log.

12.4.3.7 LONG GAP

In order to provide the Host with a longer reinstruct window for specific Host/Model 9610/9660 configurations, the long gap allows selection of four gap distances. Depending on the speed of operation these distances then translate into time periods longer than standard gaps thus increasing the reinstruct period.

The gap selections are:

.45 inches for GCR only, NRZI,PE,DDPE will default to 0.6 inches
.60 inches available for all densities.
1.20 inches available for all densities.
2.50 inches available for all densities.

12.4.3.8 GCR CORRECTED ERROR

The user has the option to report or not report errors corrected by the internal "on-the-fly" circuitry in GCR.

12.4.3.9 ARA BURST CALIBRATE

When enabled, the unit will automatically adjust the gain of the Read amplifiers when reading or writing the ARA Burst in GCR. If disabled, the default gains from the EEPROM will be employed.

12.4.3.10 NRZI CHECK CHARACTER GATE

When enabled, the CRC and LRC characters will be passed following each block in NRZI. If disabled, the characters will not be passed to the Host.

12.4.3.11 CLEAR FBSY

For Hosts that reinstruct at the removal of FBSY, this option should be set to "WITH DBY" to facilitate streaming. This option only effects the point where FBSY will go false for streaming commands. Select either "WITH DBY" to deny FBSY while still at speed or "POSTREPO" to deny FBSY after repositioning following a 100 ips command.

12.4.3.12 POLARITY IFEN

Hosts that do not support Formatter Enable (IFEN) or that consider IFEN to be a pulse to activate the unit should set the IFEN option to "INVERT". Hosts that support IFEN as described in section 6.0 should set this option to "NORMAL".

Display - Selectable Options for Tape System Setup

SET UP	=>	UNIT NUM	=> UNIT 0, UNIT 1, UNIT 2, UNIT 3,
			=> UNIT 4, UNIT 5, UNIT 6, UNIT 7
		DEFL DEN	=> 800, 800 REM, 1600, 1600 REM
			=> 3200, 3200 REM, 6250, 6250 REM
		SPEED	=> HOST SEL, AUTO, 50 IPS, 100 IPS
		TIME OUT	=> 25FT. ON, 25FT. OFF
		SECURITY	=> ENABLED, DISABLED
		PARITY	=> CHECK, IGNORE
		LONG GAP	=> 0.45 INCH, 0.6 INCH, 1.2 INCH, 2.5 INCH
		GCR CERR	=> ENABLED, DISABLED
		ARA CAL	=> ENABLED, DISABLED
		NRZI CCG	=> ENABLED, DISABLED
		CLR FBSY	=> WITH DBY, POSTREPO
		IFEN	=> NORMAL, INVERT

Warranty

The Company warrants its devices against faulty workmanship or the use of defective materials (except in those cases where the materials are supplied by OEM) for a period of one year from the date of shipment to OEM, with the exception of $\frac{1}{4}$" cartridge products which are warranted for a period of ninety (90) days.

The liability of the Company under this warranty is limited to replacing, repairing, or issuing credit (at the Company's discretion) for any devices which are returned by OEM during such period provided that (a) the Company is promptly notified in writing upon discovery of such defects by OEM; (b) the defective unit is returned to the Company, transportation charges prepaid by OEM; and (c) the Company's examination of such unit shall disclose to its satisfaction that such defects have not been caused by misuse, neglect, improper installation, repair alteration or accident.

Kennedy Company is continually striving to provide improved performance, value and reliability in its products and reserves the right to make these changes without being obligated to retrofit delivered equipment.

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